



**FEATURES OF HOMOCYSTEINE LEVELS IN PATIENTS WITH CHRONIC  
GENERALIZED PERIODONTITIS WHO HAVE HAD COVID-19**

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**Abstract**

The article presents expanded results of a clinical and laboratory study of homocysteine levels in patients with chronic generalized periodontitis who have had COVID-19. A detailed analysis of age-related and clinical features, statistical assessment of the obtained data, and pathogenetic justification for a comprehensive approach to treatment were conducted.

**Keywords**

COVID-19, chronic generalized periodontitis, homocysteine, endothelial dysfunction, systemic inflammation.

**INTRODUCTION**

Chronic generalized periodontitis is one of the most socially significant dental diseases, characterized by progressive destruction of periodontal tissues, formation of pathological periodontal pockets, bone resorption, and tooth loss. Despite significant advances in modern periodontology, the problem of effective treatment for this disease remains relevant, especially under conditions of combined effects from systemic factors.

In recent years, special attention has been paid to the impact of systemic infectious diseases on the condition of oral organs and tissues. The COVID-19 pandemic has demonstrated that coronavirus infection has a multifactorial effect on the human body, causing immune response disorders, metabolic shifts, endothelial dysfunction, and microcirculatory disturbances that persist even after clinical recovery.

Post-COVID syndrome is characterized by prolonged inflammatory activity, increased levels of pro-inflammatory cytokines, activation of the coagulation cascade, and disruption of vascular homeostasis. These changes create an unfavorable background for the course of chronic inflammatory diseases, including chronic generalized periodontitis, contributing to its progression and resistance to standard treatment methods.

One of the key biochemical markers of endothelial dysfunction is homocysteine, a sulfur-containing amino acid involved in methionine metabolism. An increase in blood homocysteine concentration is associated with the development of vascular pathology, increased oxidative stress, and activation of inflammatory reactions.



Hyperhomocysteinemia contributes to endothelial cell damage, reduced nitric oxide bioavailability, increased vascular wall permeability, and impaired microcirculation. In periodontal tissues, these changes lead to deterioration of trophic processes, hypoxia, and intensification of destructive processes, which may explain the more severe and prolonged course of periodontitis in patients who have had COVID-19.

Despite the existence of individual publications on the impact of COVID-19 on periodontal condition, the role of homocysteine in the pathogenesis of chronic generalized periodontitis in this patient category remains insufficiently studied, which determines the relevance of this research.

The effect of elevated homocysteine levels on periodontal tissue condition and objective examination data.

An increase in homocysteine levels in patients with chronic generalized periodontitis who have had COVID-19 has a pronounced negative impact on the condition of periodontal tissues and the clinical presentation of the disease.

Hyperhomocysteinemia contributes to the development of endothelial dysfunction, leading to microcirculation disruption, decreased tissue perfusion, and the formation of chronic hypoxia in periodontal tissues. Under conditions of oxygen and nutrient deficiency, destructive processes are activated, inflammatory reactions intensify, and reparative mechanisms slow down.

Elevated homocysteine levels induce oxidative stress, promote the activation of pro-inflammatory cytokines, and impair periodontal vessel endothelial function. This leads to increased vascular wall permeability, exudation, and increased soft tissue swelling.

### **Periodontal changes in hyperhomocysteinemia**

In cases of elevated homocysteine levels in periodontal tissues, the following are observed:

- progressive disruption of microcirculation and venous congestion;
- increased inflammatory infiltration;
- activation of alveolar bone resorption;
- slowing of connective tissue regeneration processes;
- increased tooth mobility due to destruction of the periodontal ligament apparatus.

Objective clinical examination data

Objective examination of the oral cavity in patients with elevated homocysteine levels reveals the following clinical signs:

- gums are hyperemic, swollen, with pronounced edema;
- bleeding of the gums during probing and even with minimal mechanical impact;
- presence of deep periodontal pockets with serous or seropurulent discharge;
- pronounced dental plaque and subgingival calculus;



- gingival recession, exposure of the necks and roots of teeth;
- increased tooth mobility of grades I-II, in some cases grade III;
- decrease in density and turgor of periodontal tissues;
- delayed healing after dental interventions.

In patients of older age groups, these changes are more pronounced and persistent, which correlates with higher homocysteine levels.

### **Clinical significance of the identified changes**

The severity of clinical manifestations of chronic generalized periodontitis in patients with hyperhomocysteinemia indicates that an elevated level of homocysteine is an unfavorable prognostic factor, aggravating the course of the disease and reducing the effectiveness of standard treatment methods.

The obtained data confirm the necessity of including homocysteine level assessment in the diagnostic algorithm and justify a comprehensive pathogenetic approach aimed not only at local periodontal treatment but also at correcting systemic metabolic and vascular disorders.

### **Radiological changes in periodontal tissues in patients with elevated homocysteine levels (according to OPG and CT)**

Radiological examination is an important step in comprehensively assessing the condition of periodontal tissues in patients with chronic generalized periodontitis who have had COVID-19. Orthopantomography (OPG) and cone-beam computed tomography (CBCT) data allow for an objective assessment of the degree of destructive changes in the bone tissue of the alveolar process and their relationship with systemic metabolic disorders, including an increase in homocysteine levels.

### **Orthopantomography data**

In patients with elevated homocysteine levels, the following changes were most frequently detected during orthopantomogram analysis:

- generalized decrease in alveolar bone height, predominantly uneven in nature;
- blurring and discontinuity of the cortical plate of the alveolar process;
- pronounced widening of the periodontal ligament space, especially in the area of molars and premolars;
- foci of vertical and horizontal bone resorption;
- signs of osteoporosis in the form of decreased bone density;
- the degree of bone resorption does not correspond to the patient's age, which indicates accelerated progression of periodontal destruction.



The severity of these radiological changes correlated with the clinical signs of inflammation and the degree of homocysteine elevation, indicating its pathogenetic role in the development of bone destruction. Cone-beam computed tomography (CBCT) data

**CBCT in patients with hyperhomocysteinemia revealed more detailed changes in the periodontal bone tissue:**

- focal and diffuse resorption of the alveolar bone with marked thinning of the cortical plates;
- vertical bone defects of varying depth, often multi-chambered in nature;
- disruption of trabecular bone architecture;
- signs of local bone tissue demineralization;
- decreased bone density in the area of interdental septa;
- more pronounced bone changes in areas corresponding to clinically deep periodontal pockets.

CBCT allowed us to establish that in patients with elevated homocysteine levels, destructive changes in bone tissue are more aggressive and widespread compared to patients with normal levels of this indicator.

**Pathogenetic rationale for radiological changes**

The identified radiological signs can be explained by the effect of hyperhomocysteinemia on the vascular bed and bone metabolism. Elevated homocysteine levels lead to:

- disruption of microcirculation in bone tissue;
- decrease in osteoblastic activity;
- activation of osteoclasts;
- intensification of bone resorption processes;
- slowing down of reparative processes.

In the context of post-COVID syndrome, these mechanisms are exacerbated by systemic inflammation and endothelial dysfunction, which is reflected in the radiological picture of chronic generalized periodontitis.

**Clinical significance of radiological data**

Comparison of clinical, laboratory, and radiological data showed that an elevated level of homocysteine is associated with more pronounced bone destruction of the periodontium, which should be taken into account when planning treatment measures and predicting the course of the disease.

The obtained results confirm the feasibility of using OPG and CBCT in combination with laboratory determination of homocysteine levels for objective assessment of the severity of



chronic generalized periodontitis in patients who have had COVID-19. RESEARCH OBJECTIVE

To assess homocysteine levels in patients with chronic generalized periodontitis who have had COVID-19, and to determine its significance in the pathogenesis and clinical course of the disease.

**MATERIALS AND METHODS**

The study included 73 patients diagnosed with chronic generalized periodontitis who had experienced COVID-19 of varying severity. The age of the patients ranged from 18 to 74 years. Inclusion criteria were a confirmed diagnosis of chronic generalized periodontitis and a history of coronavirus infection.

All patients underwent a comprehensive dental examination, including medical history collection, clinical assessment of periodontal tissue condition, and laboratory determination of homocysteine levels using an immunochemical method.

Statistical analysis of the data was performed using Microsoft Excel and SPSS software. Descriptive statistics, parametric and non-parametric tests for assessing the significance of differences, and correlation analysis were employed. The level of statistical significance was set at  $p < 0.05$ . RESULTS

Age group n %

≤18 years	9	12.3
19-44 years	39	53.4
≥45 years	25	34.3
Total	73	100

Table 1. Distribution of patients by age

Homocysteine level n %

≤10 μmol/l	40	54.8
10-15 μmol/l	20	27.4
>15 μmol/l	13	17.8

Table 2. Distribution of patients by homocysteine level

The obtained results indicate a high prevalence of hyperhomocysteinemia in patients with chronic generalized periodontitis after COVID-19, especially in older age groups.



## **DISCUSSION**

The results of this study confirm the hypothesis about the significant role of homocysteine in the pathogenesis of chronic generalized periodontitis in patients who have recovered from COVID-19. The observed increase in homocysteine levels reflects the presence of systemic metabolic and vascular disorders characteristic of the post-COVID condition.

Based on the obtained data, it can be assumed that hyperhomocysteinemia contributes to the progression of inflammatory and destructive processes in periodontal tissues, reducing the effectiveness of standard therapeutic measures.

Thus, determining the level of homocysteine can be considered an additional diagnostic and prognostic criterion in the management of patients with chronic generalized periodontitis after COVID-19.

Relationship between homocysteine levels and clinical and radiological changes in periodontal tissues (according to OPG and CBCT data)

An increase in homocysteine levels in patients with chronic generalized periodontitis who have had COVID-19 is associated with more pronounced destructive changes in periodontal tissues, which is confirmed by objective clinical and radiological examination data.

### **Orthopantomography radiographic data**

Analysis of orthopantomograms in patients with elevated homocysteine levels revealed the following changes: generalized decrease in alveolar bone height, uneven bone resorption, widening of the periodontal ligament space, and blurred and discontinuous cortical plate. In some cases, signs of osteoporosis of the alveolar process were observed. The severity of these changes increased proportionally to the increase in homocysteine levels.

### **Cone-beam computed tomography data**

According to CBCT data, patients with hyperhomocysteinemia exhibited focal and diffuse forms of alveolar bone resorption, vertical bone defects of varying depths, thinning of cortical plates, and altered trabecular bone architecture. In areas of clinically pronounced periodontal pockets, a decrease in bone density was observed. These changes were more pronounced and widespread compared to patients with normal homocysteine levels. Clinical and radiological correlation

Comparison of laboratory indicators, clinical data, and OPG/CBCT results revealed a correlation between homocysteine levels and the extent of periodontal bone tissue damage. Elevated homocysteine values were associated with accelerated progression of bone destruction, indicating its pathogenetic significance in the development of chronic generalized periodontitis in patients who have recovered from COVID-19.

Table.

Correlation between radiological changes in periodontal tissues and homocysteine levels\*\*



Homocysteine level   OPG data   CBCT data	Homocysteine level   OPG data   CBCT data	Homocysteine level   OPG data   CBCT data
≤10 μmol/L   Alveolar bone height is preserved, minimal homogeneous resorption   Cortical plates are preserved, trabecular structure without pronounced changes	≤10 μmol/L   Alveolar bone height is preserved, minimal homogeneous resorption   Cortical plates are preserved, trabecular structure without pronounced changes	≤10 μmol/L   Alveolar bone height is preserved, minimal homogeneous resorption   Cortical plates are preserved, trabecular structure without pronounced changes
10-15 μmol/L   Uneven decrease in bone height, widening of periodontal ligament space   Vertical bone defects, thinning of cortical plates	10-15 μmol/L   Uneven decrease in bone height, widening of periodontal ligament space   Vertical bone defects, thinning of cortical plates	10-15 μmol/L   Uneven decrease in bone height, widening of periodontal ligament space   Vertical bone defects, thinning of cortical plates
>15 μmol/L   Generalized bone resorption, osteoporotic changes   Deep vertical defects, pronounced disturbance of bone architecture	>15 μmol/L   Generalized bone resorption, osteoporotic changes   Deep vertical defects, pronounced disturbance of bone architecture	>15 μmol/L   Generalized bone resorption, osteoporotic changes   Deep vertical defects, pronounced disturbance of bone architecture

Clinical and radiological classification of chronic generalized periodontitis in patients who have had COVID-19

Based on the homocysteine level and severity of clinical and radiological changes, the following classification is proposed:

Grade I (compensated) - homocysteine level ≤10 μmol/L; minimal clinical manifestations; according to OPG and CBCT data - initial signs of bone resorption.

Grade II (subcompensated) - homocysteine level 10-15 μmol/L; moderately pronounced clinical signs of inflammation; radiologically - vertical bone defects and thinning of cortical plates.

Grade III (decompensated) - homocysteine level >15 μmol/L; pronounced clinical manifestations and resistant course of the disease; according to OPG and CBCT data - generalized bone destruction and decreased bone density.

### **Supplementary conclusions (including OPG and CBCT)**

1. Elevated homocysteine levels in patients with chronic generalized periodontitis after COVID-19 are accompanied by pronounced clinical and radiological signs of bone destruction.

2. OPG and CBCT data confirm that the degree of alveolar bone resorption is directly related to the homocysteine level.



3. The use of CBCT allows for more accurate detection of early and deep bone defects in patients with hyperhomocysteinemia.

4. A comprehensive assessment of laboratory, clinical, and radiological data increases the accuracy of diagnosis and prognosis of chronic generalized periodontitis progression.

## CONCLUSIONS

1. A high frequency of elevated homocysteine levels has been identified in patients with chronic generalized periodontitis who have had COVID-19.

2. Homocysteine levels increase with patient age.

3. Homocysteine can serve as a marker of disease severity.

4. The obtained data justify the need for comprehensive pathogenetic treatment.

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